



Group value and intention to use – A study of multi-agency disaster management information systems for public safety[☆]

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ABSTRACT

This paper examines and extends the theory of information systems success in the context of large-scale disaster management (DM) for public safety. In the recent past, various evaluation reports on DM efforts have concluded that information quality and system quality are major hurdles for efficient and effective multi-agency DM and are critical antecedents for information systems (IS) success. In contrast to the wealth of literature on IS success in profit-oriented business environments, research regarding drivers of public sector IS success is scarce. This research develops and empirically tests a model that explains IS usage intention as a reflective measure of IS success in the public sector DM domain. In this paper, the effects of the expected value of IS for the entire group of collaborating DM agencies, task support, user satisfaction, and three specific information/service quality dimensions on usage intention are examined. Data was collected from emergency responders using a questionnaire survey method during multi-agency, cross-national DM exercises at the Dutch–German border. The results of the data analysis revealed that expected group value is a key determinant of intention to use in the public sector DM domain. The data analysis also showed that perceived task support only has an indirect effect, through user satisfaction, on the usage intention. These findings imply that previously suggested IS success models for business environments are likely to fall short in their explanatory power and applicability for highly volatile complex disaster environments that require immediate coordinated responses from a large number of organizations. Possible directions for future research are also discussed along with other findings and implications.

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1. Introduction

The use and performance of communication and decision support systems in disaster management (DM) have attracted the attention of researchers for over two decades [52]. However, it is only recently that researchers have started to emphasize decision support and information sharing across different DM agencies as well as the quality of the shared information. The main reason for the current emerging interest may lie in the fact that evaluation reports on some recent disasters, such as 9/11 [20], the SARS outbreak in Asia [45] and the fire in the Schiphol Retention Complex [62], have revealed that

poor information quality hampered the efficiency and effectiveness of interagency disaster response activities. For example, during the response to the 9/11 attacks fire fighters were not able to receive the information about the WTC towers that police had [20]. Information about the structure of the WTC towers only became available to DM organizations several days after the disaster [20]. A common problem is the fact that although most of the data objects are available somewhere in the complex network, the processing of the data objects into relevant information accessible to the right person at the right time is missing.

Response to disasters, whether natural (e.g., floods, earthquakes) or human induced (e.g., terrorist attacks), is a complex process [11] that involves severe time pressure [51], high uncertainty [4] and many stakeholders [15], which results in unpredictable information needs [38]. In other words, DM operations are information-intensive activities [17,21]. However, most disaster responders have to cope with incomplete, unavailable and/or outdated information when a disaster strikes. Access to quality information is essential for DM agencies to decide and act under demanding conditions [31] since poor information quality can be lethal for both emergency responders and victims [27,58]. Accordingly, decision-making pertaining to the

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hazards of a disaster relies heavily on effective information sharing and coordination between a large number of autonomous actors including various DM agencies, private organizations, and civilians [9]. The challenges for individual or group decision support systems in disaster response situations are both diverse and massive. The people who must work together have no history of doing so, they have not developed a trust or understanding of one another's abilities, and the totality of resources they each bring to bear have never before been exercised [61].

There is a wealth of literature on information quality and information systems (IS) success in the profit-oriented business environment. However, research on the drivers of IS success in the public sector where attaining the public good is often an important goal is relatively scarce. One exception is the work done by Fisher and Kingma [27], which underlines the criticality of IQ for DM. Public goods, such as public safety that this study focuses on, are delivered for the welfare of people (instead of for profit), ideally in a non-rival and non-exclusive manner for all societal groups. In disaster response situations characterized by highly volatile and chaotic environments, decision makers are forced to make swift decisions based on limited and/or incomplete information. This can put them under an extreme amount of pressure due to the immediate and potentially catastrophic consequences for making the wrong decision. Therefore, previously developed models of IS usage and success in a business environment are likely to fall short in their explanatory power and applicability in public domains in general and DM in particular. Another gap in the IS literature is that testable hypotheses and empirical (especially quantitative) studies are relatively scarce in the DM domain. One practical reason for this may be the fact that it is difficult to collect empirical data during a real disaster since the situation is unforeseeable, dangerous, and may prohibit researchers from approaching the disaster site. Furthermore multiple contexts, events, scope, control and time related problems make it difficult to collect data in disaster field studies [36]. In order to close the gap in the understanding of IS success this research develops and empirically tests a model of IS success for the DM domain in the public sector. Following a recent study in the IS success area [65], we adopt emergency responders' IS usage intention as a proxy measure of IS success. We examine the effects of expected value of the IS for the whole group of collaborating DM agencies, task support, user satisfaction, and three specific information/systems quality dimensions on the usage intention. For the empirical testing of our model, we analyze questionnaire survey data collected from professional emergency responders during a series of multi-agency, international DM exercises at the Dutch-German border.

This research is geared toward improvement of IS design for public sector applications. In the process of achieving this objective the study also enhanced our understanding of IS success in the multi-agency DM context. The contribution of this paper is twofold. First, the study extends previous IS success models by theorizing and empirically validating the effects of expected group value (as opposed to the value to an individual organization). With expected group value, the extended model can explain why some IS' don't work in public sector applications while comparably designed IS' work fine in private sector applications. The second contribution of the study comes from the examination of relevant information quality (IQ) and systems quality (SQ) attributes expected to play important roles in the DM domain. This domain-specific knowledge provides the researchers in the DM domain with an important empirical baseline for future research in addition to being used as a design guideline by practitioners (e.g., IS designer/developer) in the domain. The analytical framework and findings can also offer useful insights into other domains with similar characteristics such as high pressure, multiple stakeholders, uncertainty, unpredictable information needs, and orientation toward public services.

In the following section the theoretical foundation of our model of disaster management information systems (DMIS) success is pre-

sented. The research design and method of the study are explained in a subsequent section followed by the results of the data analysis. The paper concludes with a discussion about the implications of the findings and directions for future research.

2. Theoretical background

This study builds on the previous literature in the IS success area that suggests various IS success measures and their antecedents. DeLone and McLean's model of IS success [22] has provided a foundational structure of IS success related variables. In DeLone and McLean's model IS success is measured at both individual and organizational levels and is determined by systems use and user satisfaction. In their model, systems use and user satisfaction fully mediate the effects of IQ and SQ on individual and organizational impacts. A multitude of IS related models have been derived from the DeLone and McLean model including various models of systems success, user satisfaction, technology acceptance and use, and IQ/SQ [48,67]. The Technology Acceptance Model (TAM) is one of the extensions designed to predict acceptance and usage of new technology in an organization [18] and then is generalized in various contexts [63] based on socio-psychological theories of human behavior such as Theory of Reasoned Action (TRA) [26] and Theory of Planned Behavior (TPB) [2,54]. DeLone and McLean [23] have also updated their model by replacing individual and organizational performances with net benefit. The updated model also distinguishes usage intention and service quality from systems use and systems quality, respectively. In this section we scrutinize and integrate the aforementioned theories to identify key variables that can reflect IS success in the public sector in general and DM in particular. In addition, we develop a model that hypothesizes the relationships among the key IS success variables and their determinants.

2.1. IS success in multi-agency disaster management

A recurring challenge in organizational IS success research is the ability to understand the linkage between IS and its impact on organizational performance. Au et al. define IS performance as "perceived outcome from IS use" ([5] p. 46) and argue that there are strong relationships between user satisfaction and intention to use. The majority of IS success studies in the past were conducted in the private sector business environment where decisions are made under less time-pressure and uncertainty in comparison to disaster situations [37]. Consequently, the focus of those studies was on realizing the potential of the IS in question to improve individual users' performance. An assumption in those studies is that the performance of an organization co-varies with the sum of the performance of individuals within the organization. For example, in the original DeLone and McLean model [22] individual impact was considered as the dominant determinant of organizational impact, while systems usage was suggested as a surrogate measure for IS success. Their updated model [24] does not distinguish between individual and organizational level impacts. It uses a single-construct performance measure (i.e., net benefits) that embraces various concepts such as cost and time savings, market expansion, increased sales, and reduced search costs. DeLone and McLean have also pointed out the difficulty of isolating the contribution of IS from other contributors to organizational performance. This prevented attempts to measure the impact of IS on overall organizational performance. It is likely that this problem also exists in the public sector inter-organizational IS context. The problem is even more serious in multi-agency disaster response situations where IS is used to support not only individuals' primary responsibilities within his/her own agency but also the coordination of multi-agency DM operations that are focused on enhancing public safety.

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